DEMANDS FOR LAND FOR AGRICULTURE - PAST, PRESENT, AND FUTURE

by

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Land and Water Economics Branch

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The land area of the United States must fulfill increasing demands from a growing population and a continuously developing economy. As they have in the past, demands for land and its products and services will change in form and intensity. The supply of agricultural land is likely to be subject to increasing pressure from urbanization and greatly expanded public installations and facilities. Such uses are creating demands for land which to a large extent were nonexistent or insignificant throughout much of our history.

The demand for land is made up of a multitude of demands from different segments of the economy. Some of these are for land for direct consumption uses, such as use for a homesite. Other demands are derived from the need for products that must go through many steps of additional processing before reaching the ultimate consumer. On the supply side, there are many unique characteristics of land, water and other natural resources--relatively limited quantity, relatively fixed productive capacity under a given state of technology, and immobility as to location. Decisions regarding land use are often irreversible. The sequence of use and timing are extremely important. Since many of the demands for land are derived and because of the unique characteristics of land supply, it is difficult to analyze the demand for land in the sense that one might analyze the demand for an agricultural commodity or an industrial product.

Agriculture--the production of food and fiber for domestic consumption and export--is the most important claimant upon land. From early settlement of the United States until the present there has, in general, been sufficient land available to satisfy the agricultural needs of the Nation with more than enough left over to fulfill the nonagricultural needs. Aided by the availability, conquest and development of frontier lands, and technological revolutions in production techniques, our agriculture has forcefully repudiated the predicted Malthusian consequences of population growth.

1/ We wish to acknowledge the helpful suggestions received from our colleagues in ERS, particularly Hugh H. Wooten.

But what about the future? Will more land be needed to produce the increased food and fiber requirements of an expanding population, thereby causing increased agricultural demand to compete with an expected increased nonagricultural demand for land? Or will we be able to meet future agricultural requirements with less land than now used, thereby releasing to nonagricultural uses some land currently in agricultural uses? Answers to questions such as these are requisite to the formulation of land policy.

This paper focuses on the past, present, and future use of land for agriculture in the United States. Historical trends in use and the expansion of agriculture through new land settlement are briefly reviewed. The changing structure of modern agriculture is examined in some detail. Factors determining future demands for the products of land are appraised. Based upon a set of assumptions about these factors and about resource productivity, estimates of land requirements for agriculture in 1980 are presented. The potential for meeting demands for agricultural products further in the future is briefly discussed.

Native Vegetation - An Indicator of Land Use

Native vegetation reflects environment and is the product of past and present climatic and soils factors. As such, it is a good indicator of the inherent suitability of land for agriculture. A look at the native vegetation of the United States reveals the high quality and broad extent of the land resource base.

In its natural state about half (48 percent) of the land area of the continental United States was forested (fig. 1). The forests formed

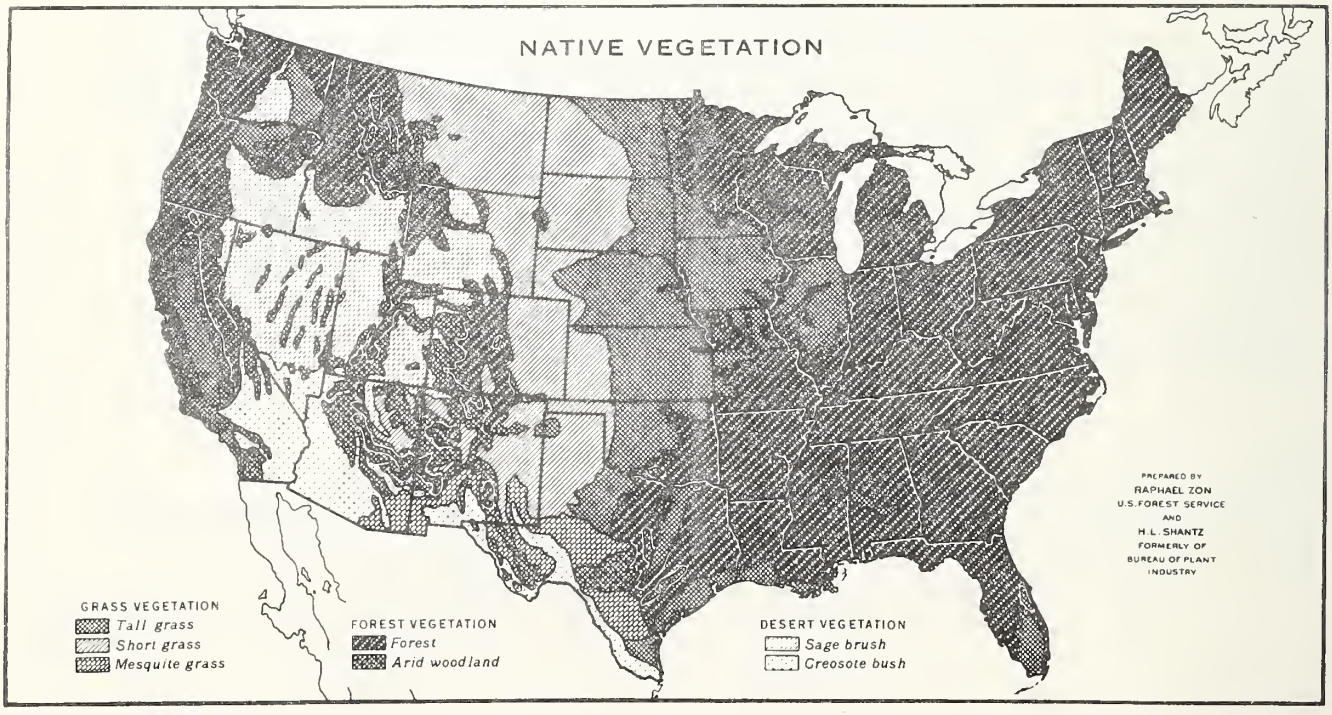

Figure 1

two belts, one inland from the Atlantic Coast and the other inland from the Pacific Coast. The Eastern forest was predominantly broad-leaved, but with extensive areas of pine in the Southeast and of spruce, fir and other conifers in the Northeast. This forest was distributed over both valleys and mountains; it covered nearly all of the humid East, except the prairies, extending into parts of the present States of Minnesota, Iowa, Missouri, Oklahoma, and Texas. The Western forest was principally coniferous, and was concentrated along the Pacific Coast with scattered segments throughout the mountain areas west of the Great Plains.

Nearly two-fifths (38 percent) of the land area was covered with grasses. The bulk of the grasslands was located in a broad belt separating the Eastern and Western forests. This central grasslands area was divided into two parts, the tall grass (prairie grassland) and the short grass (plains grassland) areas. The tall grass area was characterized by a plentiful supply of rainfall. It occupied 16 percent of the present total land area of the United States. Tall grasses east of the Mississippi River principally were located in Illinois, the black-belt of Mississippi and Alabama, and the Florida Everglades. The short grass area, characterized by more limited rainfall, began at about the one-hundredth meridian and extended westward to the mountains, accounting for about 14 percent of the total land area. Other grasses, such as mesquite, bunchgrass and marshgrass covered 8 percent of the United States.

Desert shrub vegetation grew over the remaining 14 percent of the United States. These shrubs were adapted to limited rainfall and grew throughout the intermountain region where rainfall or other environmental factors were not conducive to other types of vegetal growth.

Expansion of Land Settlement and Development

Although the natural characteristics of land have strongly influenced both the pattern of settlement and the use of land, geographic location was perhaps the greatest single factor affecting the growth of the earliest settlements in the United States. The first settlement along the Atlantic Coast at St. Augustine, Fla., in 1565 was slow to grow. The second settlement at Jamestown, Va., in 1607 and subsequent settlements along the Chesapeake Bay also grew slowly. After the initial arrival of settlers in the North Atlantic colonies, however, their numbers grew more rapidly. Good harbors and a somewhat shorter sailing distance across the North Atlantic to Europe gave impetus to a steady stream of European immigrants into these colonies.

The development of agricultural lands in the United States resulted from the conquest of the frontier by an expanding, westward-bound population. Since a population census was never taken in the colonies, it is possible to trace population movements accurately only after 1790, the year of the first census. In 1790, the population of the thirteen States and unorganized territory was estimated as approximately 3.9 million people. Settlement extended from Maine to southern Georgia but was confined almost entirely within the Atlantic Plain, reaching an average depth of penetration from the Atlantic Coast of 255 miles. 2/ The Alleghany and Appalachian Mountains were natural barriers to the westward movement, but by 1790 settlement had begun to penetrate beyond them. More than twenty isolated settlements in the "western wilderness," however, accounted for less than 5 percent of the population. 3/

Although hunters and trappers in search of game led the way, early settlement inland from the Atlantic Coast was principally agricultural. In most cases settlement took place on the more productive soils. Transportation access to the Atlantic seaboard was important and thus inland population movements also tended to follow navigable streams.

As the population moved westward forest lands were cleared and converted to agricultural uses. It has been estimated that there were 30 million acres of improved lands in the United States in 1790, of which 8 million were tilled or in gardens and orchards, 8 million were devoted to meadow and fallow, and 14 million were improved pasturelands. 4/ Agricultural products produced on these lands were more than sufficient to meet domestic requirements and the surplus was exported in exchange for commodities or articles not produced in the United States. Principal agricultural exports included wheat, flour, corn, cornmeal, and raw tobacco; other important exports were rice, beef, pork, manufactured tobacco products, cotton, and flaxseed. 5/

2/ U.S. Bureau of the Census. Statistical Atlas of the United States. U.S. Govt. Print. Off., Wash., D.C. 1914, p. 13.

3/ Ibid.

4/ Blodgett, Jr., Samuel. Economica: A Statistical Manual for the United States of America. City of Washington, printed for the Author, 1806, p. 60.

5/ Pitkin, Timothy. A Statistical View of the Commerce of the United States of America. James Eastburn and Co., New York, 1817, pp. 109-143.

Heavy immigration continued into the 19th century and the ever-increasing population pushed westward beyond the mountains. This westward population thrust was not uniform and, in general, did not represent a directed or organized effort to settle the land. Pioneers chose their own routes and usually after crossing the mountains followed rivers and settled in the valleys. Large pockets of unsettled lands to the rear of the frontier were bypassed and left for later settlement.

By 1850, the population of the United States had increased to about 23.3 million inhabitants. The frontier had been extended to eastern Minnesota, central Iowa, the western borders of Missouri and Arkansas, and eastern Texas, a line roughly coinciding with the western limit of the Eastern forest area (fig. 2). Having advanced through the forested lands, agricultural settlement was beginning to spread on to the prairies. A few pioneers had penetrated farther west to settle in Oregon, Utah, and California.

Since the United States economy was principally agrarian during the first half of the 19th century, the development of agricultural lands accompanied, and corresponded to, the westward population migration (fig. 3). By 1850, lands in farms embraced 294 million acres, of which 113 million acres were cropped and 181 million acres were farm woodlands, some of which were used for grazing. 6/ The extent of land development between 1790 and 1850 is particularly impressive when it is remembered that the virgin forests had to be cleared before much of the land could be used for crops.

Throughout the last half of the 19th century, the strong current of westward migration continued. This population movement was facilitated by completion of the transcontinental railroad in 1869 and was encouraged by public policy which sought to dispose of the public domain and bring about concomitant economic development of the West through such devices as the Homestead Act of 1862 and the Desert Land Act of 1877. By the turn of the century settlement was fairly general to the Pacific Coast (fig. 2). The expansion of dryland farming coupled with the irrigation of about 7½ million acres in the West 7/ has increased the amount of cropland in the United States to 319 million acres. 8/ The Corn Belt had already assumed its role as the dominant agricultural area in the Nation (fig. 3).

6/ U.S. Bureau of the Census. Historical Statistics of the United States, Colonial Times to 1957. Wash., D.C. 1960, p. 239.

7/ Baker, O.E. Rural-Urban Migration and the National Welfare. Annals of the Association of American Geographers, Vol. XXIII, p. 63.

8/ U.S. Bureau of the Census. Historical Statistics of the United States, Colonial Times to 1957, p. 239.

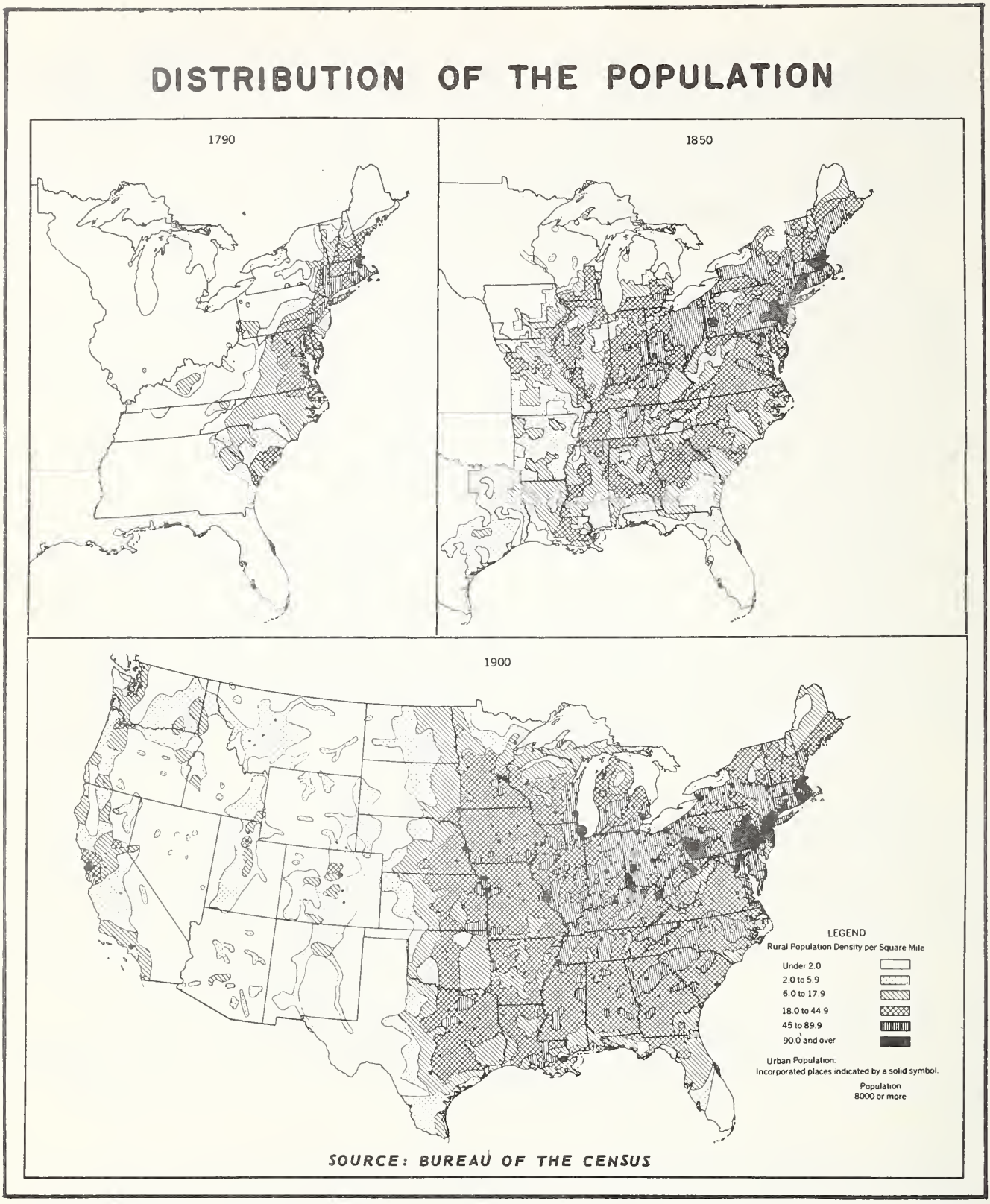
DISTRIBUTION OF THE POPULATION
1790
1850
1900
LEGEND
Rural Population Density per Square Mile
Under 2.0
2.0 to 5.9
6.0 to 17.9
18.0 to 44.9
45 to 89.9
90.0 and over
Urban Population:
Incorporated places indicated by a solid symbol.
Population
8000 or more
SOURCE: BUREAU OF THE CENSUS
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 1147-62(5) ECONOMIC RESEARCH SERVICE

Figure 2

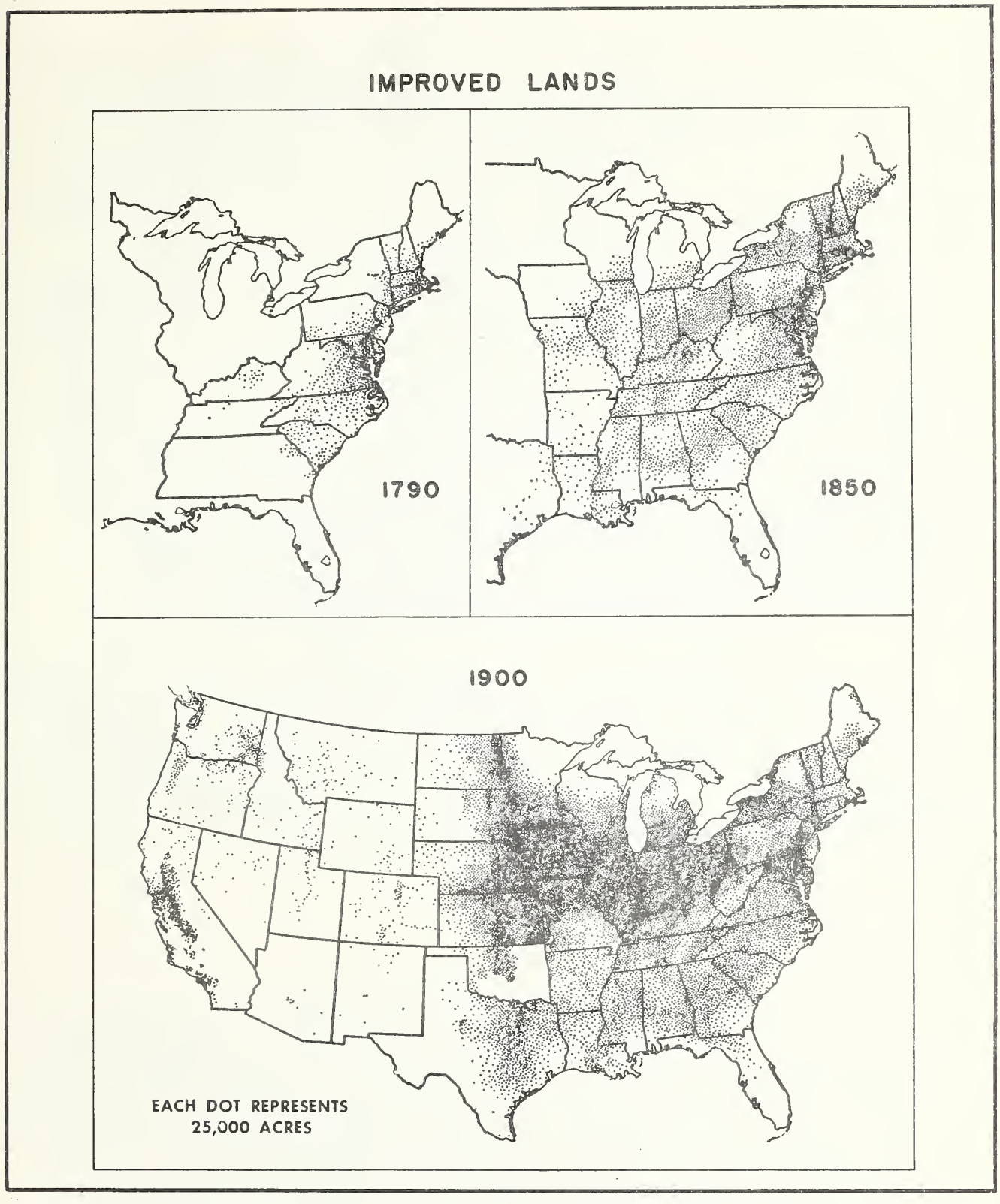
IMPROVED LANDS
1790
1850
1900
EACH DOT REPRESENTS
25,000 ACRES
U. S. DEPARTMENT OF AGRICULTURE
NEG. ERS 1148-62(5) ECONOMIC RESEARCH SERVICE

Figure 3

The conquest of arid and semiarid lands extended into the 20th century. The Enlarged Homestead Act of 1910 and the Stockraising Homestead Act of 1916 stimulated the increased agricultural use of arid and semiarid lands. By 1920, dryland farming in the Great Plains region and irrigation in the West had been greatly expanded and total cropland in the United States had been increased to 402 million acres. 9/

But although the population of the United States numbered only about 106 million people in 1920, the areal expansion of agriculture was nearly completed. Agricultural migration to the West had practically ceased even though there was still a heavy migration to West Coast cities. There were signs that agriculture was beginning to contract in some areas. A decrease in improved lands was apparent in the Northeastern and locally in some South Atlantic States. The United States had been settled and young people were beginning to migrate from farms to cities. The stage was set for structural changes producing the agricultural industry that we have today.

The Changing Structure of Agriculture

During the period 1920 to 1960 the population of the United States increased by 73 million people, or by 69 percent. The average rate of increase in national income was much more rapid--these four decades were a period of great economic growth. If we accept the likelihood of continued economic progress, a review of the impact of these changing conditions on agriculture, and its response to them, provides insight into the probable future requirements for land for agriculture.

Trend in Land Utilization

Perhaps the most significant observation relating to trends in land use since 1920 is that the needs of the Nation for agricultural products have been met with a relatively stable, or slightly declining, cropland base (fig. 4). From a peak of 480 million acres reached between 1920 and 1930, cropland in the 48 contiguous States had declined to 457 million acres by 1959. During the 1950's alone, cropland decreased by 4 percent. The decrease since 1920 has not been at a uniform rate. In the late 1930's there was a decline in cropland of about 13 million acres, with a regain prior to 1950 of about 11 million acres. The decline in the acreage of cropland harvested during the decade of the 1950's was even sharper--a drop of about 10 percent.

9/ Ibid.

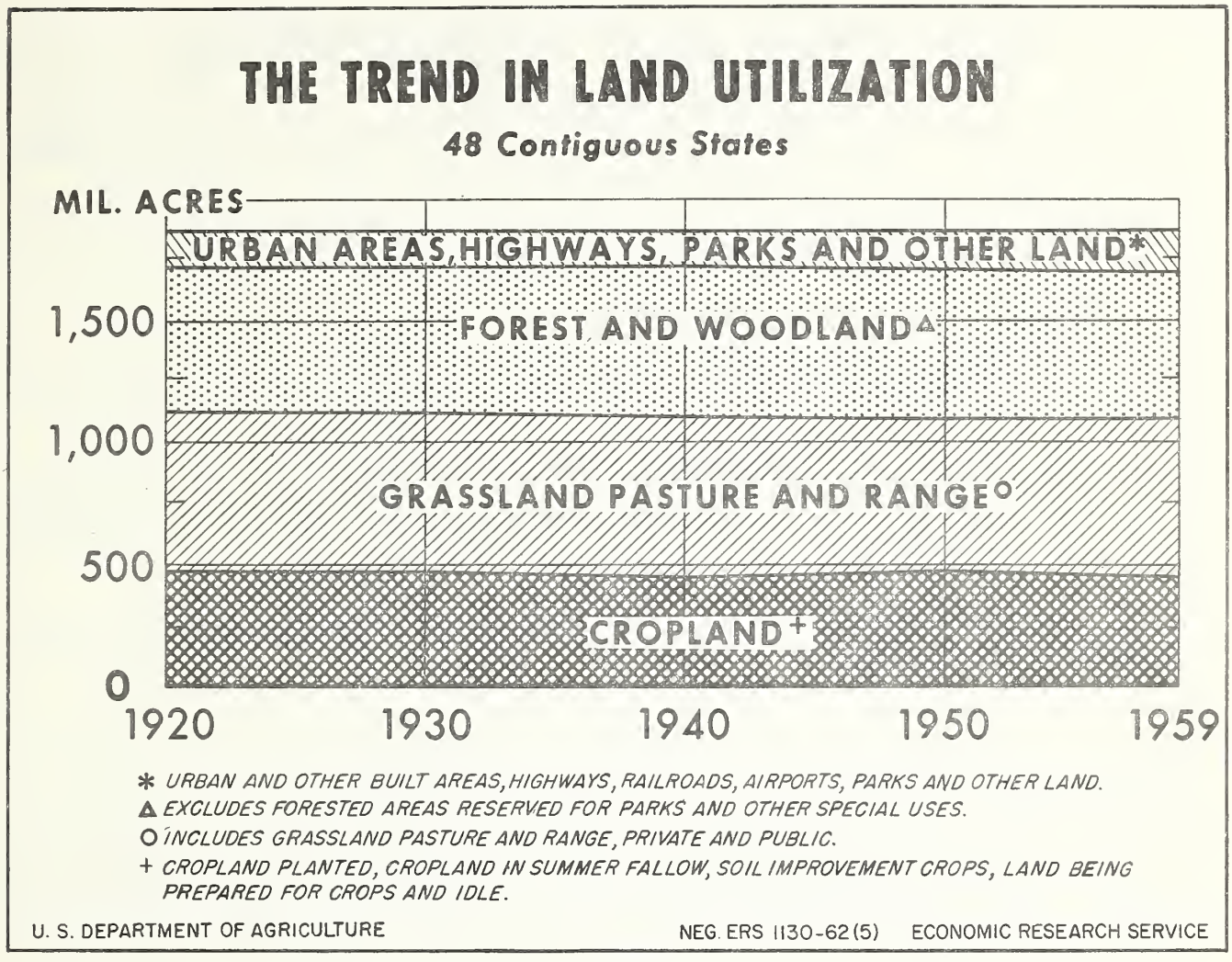

Figure 4

Aggregate figures tend to obscure important regional shifts in cropland use. For example, from 1950 to 1960 approximately 10 percent of the agricultural counties showed significant increases in cropland acreage. These increases were more than offset, however, by decreases in other counties, sometimes within the same State or region. In general, there has been a tendency for the amount of cropland to decrease in the East, increase in the West, and remain relatively stable in the Central States. Regional shifts reflect the concentration of crops in the more productive areas, the reversion of marginal lands to grass or forests, and the continued development of arid and other potentially productive lands. Recent cropland development, however, has not kept pace with reversion of cropland to other uses, including nonagricultural uses. Only 12 of the 48 contiguous States showed significant increases in cropland from 1950 to 1959. Nine of these States were in the West and three in the Corn Belt. A number of Northeastern and Southeastern States lost cropland acreage.

It may also be noted from figure 4 that the acreages of pasture and nonforested range, and forests and woodlands, have been relatively stable during the past four decades. Pasture and nonforested range has gradually declined from 652 million acres in 1920 to 630 million acres in 1959. This decrease has resulted principally from reversion of grassland to forest in the forest areas, or absorption by non-agricultural uses. Excluding reserved forest areas, forest and woodlands have increased by 12 million acres since 1920. 10/

In both absolute and percentage terms the greatest change in land use since 1920 has been the increase in special-purpose uses such as urban areas, highways and roads, farmsteads, parks, and wildlife refuges. During the 1950's the average rate of absorption of rural land by special-purpose uses was about 2 million acres per year. Approximately 40 percent of the land shifted to special-purpose uses consisted of cropland and grassland pasture, and about 40 percent was obtained from forest and 20 percent from idle land.

Growth of Farm Output

In spite of less cropland being devoted to agricultural production, gross farm output has been trending upward during the past four decades (fig. 5). In 1960 it was 83 percent greater than in 1920, compared with the population increase of 69 percent during the same period. As illustrated in figure 5, since the early 1940's gross farm output has exceeded the domestic requirements of the growing population. Breaking down the composition of gross farm output, we find that the production of livestock and livestock products has increased somewhat more than crops.

Productivity of Land

The great increase in farm output from a relatively constant cropland base has been achieved principally through increased application of nonland capital inputs to land, including the development of highly productive land through irrigation, flood control, and drainage. These inputs have been made available and their costs lowered through technological advances. Although absolutely essential, land is but one of several resources necessary in the production process. Within physical capabilities and economic limits, many resource mixes may be combined with land to achieve a given level of output. Undoubtedly, the increased application of capital inputs to land has been stimulated by production control programs for some crops which have limited acreages but have not limited capital inputs or quantities produced.

10/ Forest and woodlands have increased from 614 million acres in 1920 to 639 million acres in 1959 if areas reserved for parks, wildlife refuges and other special uses are not excluded.

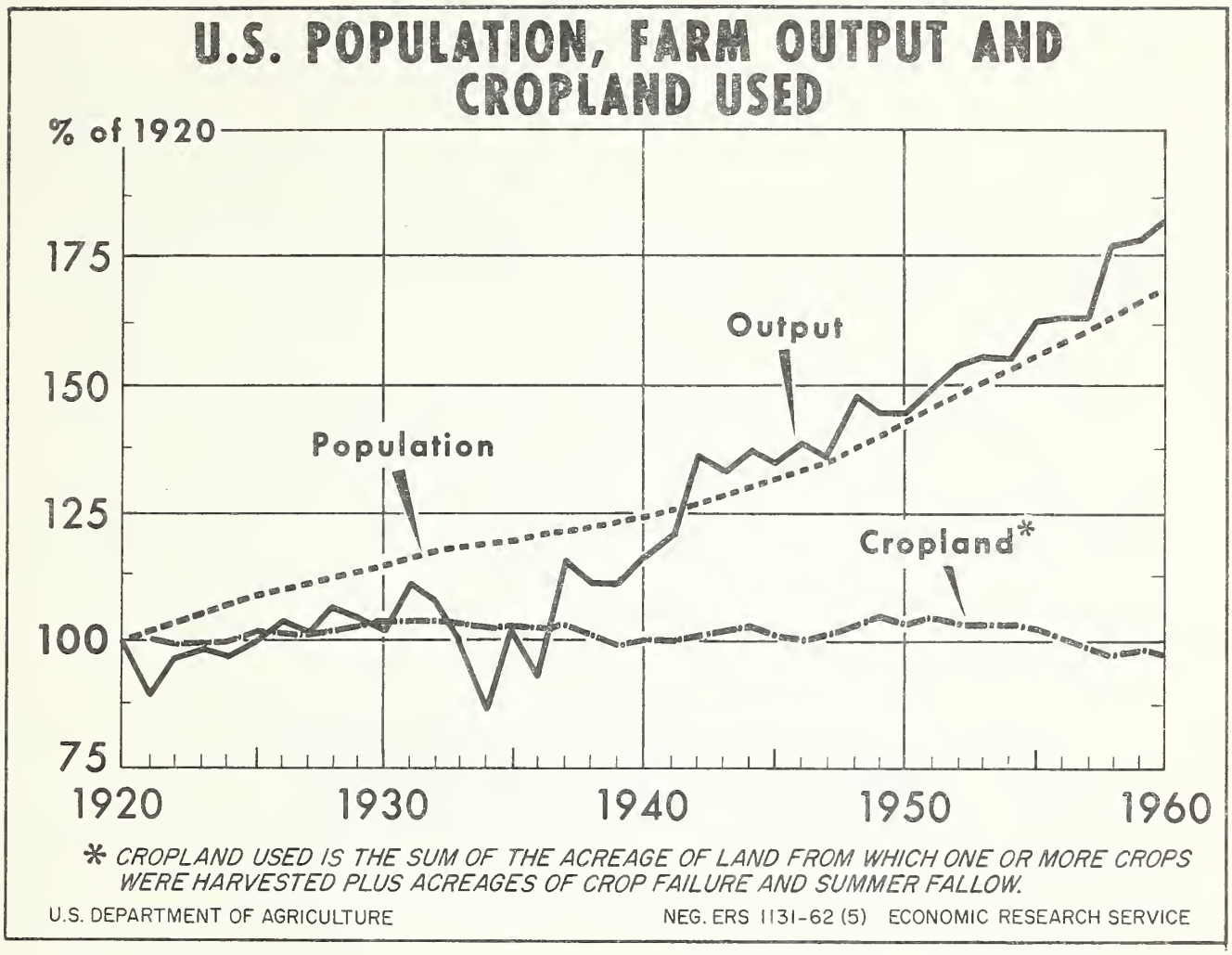

Figure 5

With acreage controls, the amount of the land resource that may be used is fixed, and the extent to which capital inputs are applied to land depends upon their prices relative to the prices of the commodities they produce. During World War II the price structure encouraged adoption of new technologies. Although the parity ratio has been declining since the war, the costs of production-increasing technologies relative to product prices have continued to make it profitable to increase the application of capital inputs to land.

Increased application of capital inputs to land has also taken place in the production of crops not restricted by acreage controls. The extent to which capital inputs are applied depends not only upon the price of the product but also upon the relative prices of land and capital resources. Frequently, farmers have found it profitable to apply additional capital resources, for example fertilizer, in the production of nonsupported crops rather than to expand their acreages.

The impact of technological innovations on land use requirements is not necessarily confined to innovations directly affecting the productivity of land. For example, a development in animal nutrition that improves the feeding efficiency of livestock permits a given output of product from less feed. Since less feed is required, less land is required to produce it. Hence, such a development indirectly increases the productivity of land. Excepting broilers and turkeys, no spectacular breakthroughs in feeding efficiency have occurred during the past 40 years. But some progress has been made and the technical possibilities for major advances are known.

Thus the technological developments which have increased agricultural productivity are many and varied. They are biological as well as mechanical and include fertilizers, power machinery, mechanical equipment, pesticides, herbicides, and insecticides, to name only a few. Although necessarily limited in the number of resources shown, figure 6 illustrates the nature of the revolution in the adoption of technology which has produced a large increase in output per acre and an even greater increase in output per man hour.

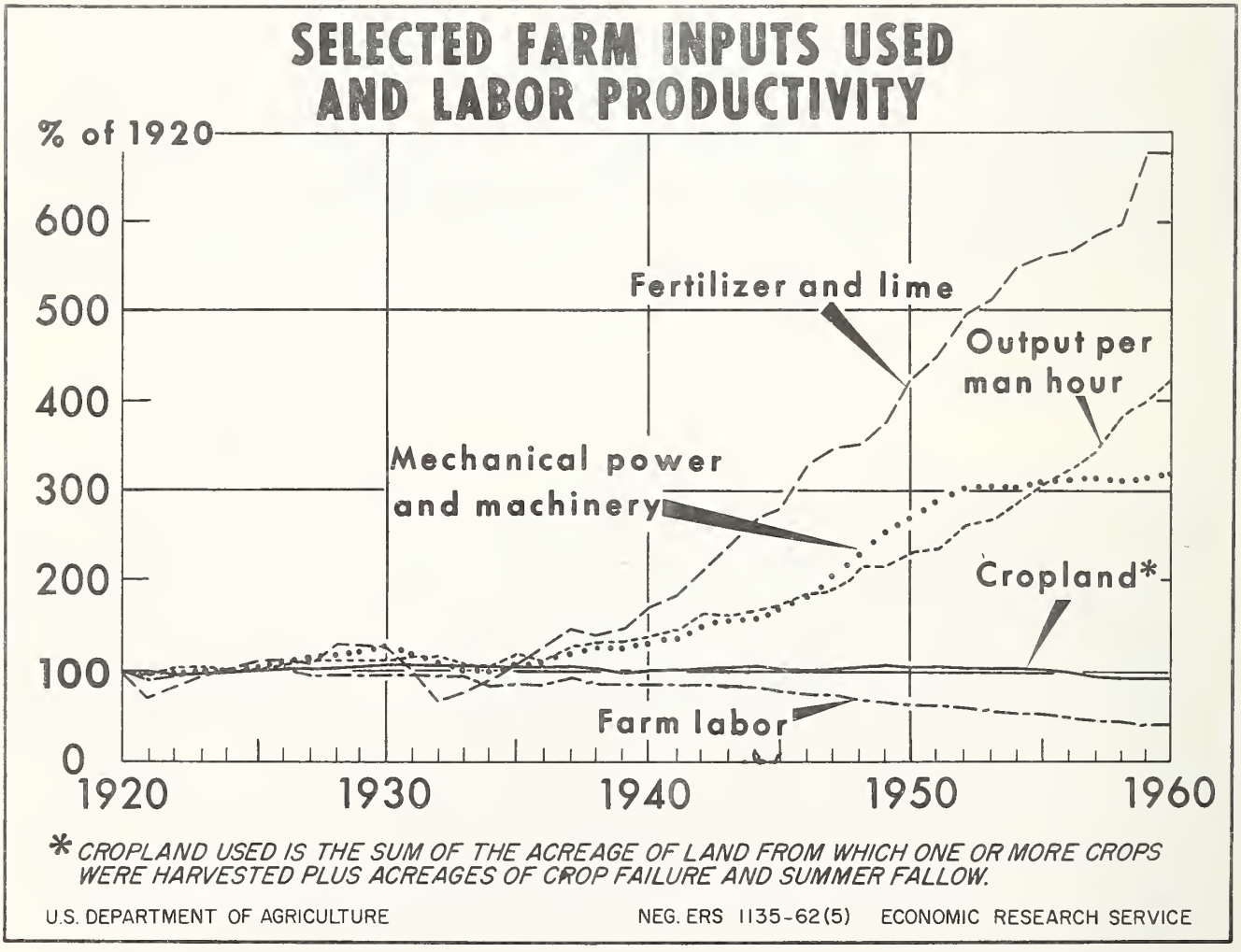

Figure 6

From figure 6 we may observe that since 1920 we have moved rapidly from the "horse age" to mechanized power. This transition was most rapid during the forties and by now it is nearly complete. The increasing use of commercial fertilizers and lime has been no less dramatic, and it seems that we are still far from achieving an economic optimum with respect to these inputs. In 1960 farmers used about 575 percent more fertilizer and lime than in 1920. Most of the increase in fertilizer use came during the latter half of this period. Associated with the adoption of power and mechanical equipment has been a decline of more than 50 percent in the man-hours of labor used in agriculture. This, coupled with the increase in farm output, has resulted in a more than quadrupled output per man-hour since 1920.

In addition to reducing labor requirements in agriculture, mechanization has released for production for human consumption much cropland formerly required to produce feed for horses and mules. The 83-percent increase in farm output illustrated in figure 5 represents farm production available for eventual human use and, therefore, excludes the production required to furnish the energy requirements of draft and riding animals. Hence, a part of the increase in output is attributable to the decrease over time of feed requirements of horses and mules. It has been estimated that about 51 percent of the increase in farm output realized during the 1920's and 1930's and about 23 percent of the increase achieved from 1940 to 1955 is attributable to the reduction in farm-produced power. 11/ Cropland as shown in figure 5, however, includes those acres used for production of feed for draft and riding animals and, therefore, does not accurately picture over time the acreage used to produce products for human use.

The importance of the decline in numbers of horses and mules and the consequential release of cropland to production of products for human consumption is revealed in figure 7. Whereas in 1920, 90 million acres of harvested crops, or 1 in every 4, produced feed for horses and mules, in 1960 only 5 million acres, or 1 in every 65, produced feed for these animals. The net effect has been that although 36 million fewer acres of cropland were harvested in 1960 than in 1920, the amount of land used for producing products for human use was greater by 49 million acres, an increase of about 18 percent.

Most of the released acreage has been used for producing products for domestic consumption. In 1960 this acreage was up 45 million acres from 1920, an increase of 21 percent. Acreage producing products for export has fluctuated widely during this period, with no perceptible trend. In 1920, 1 of every 6 acres of crops harvested produced export products as compared with about 1 of 5 in 1960, but within this interval the relative importance of export requirements varied substantially.

11/ Durost, Donald D. and Barton, Glen T. Changing Sources of Farm Output. U.S. Dept. Agr., Prod. Res. Rpt. 36, Feb. 1960, p. 17.

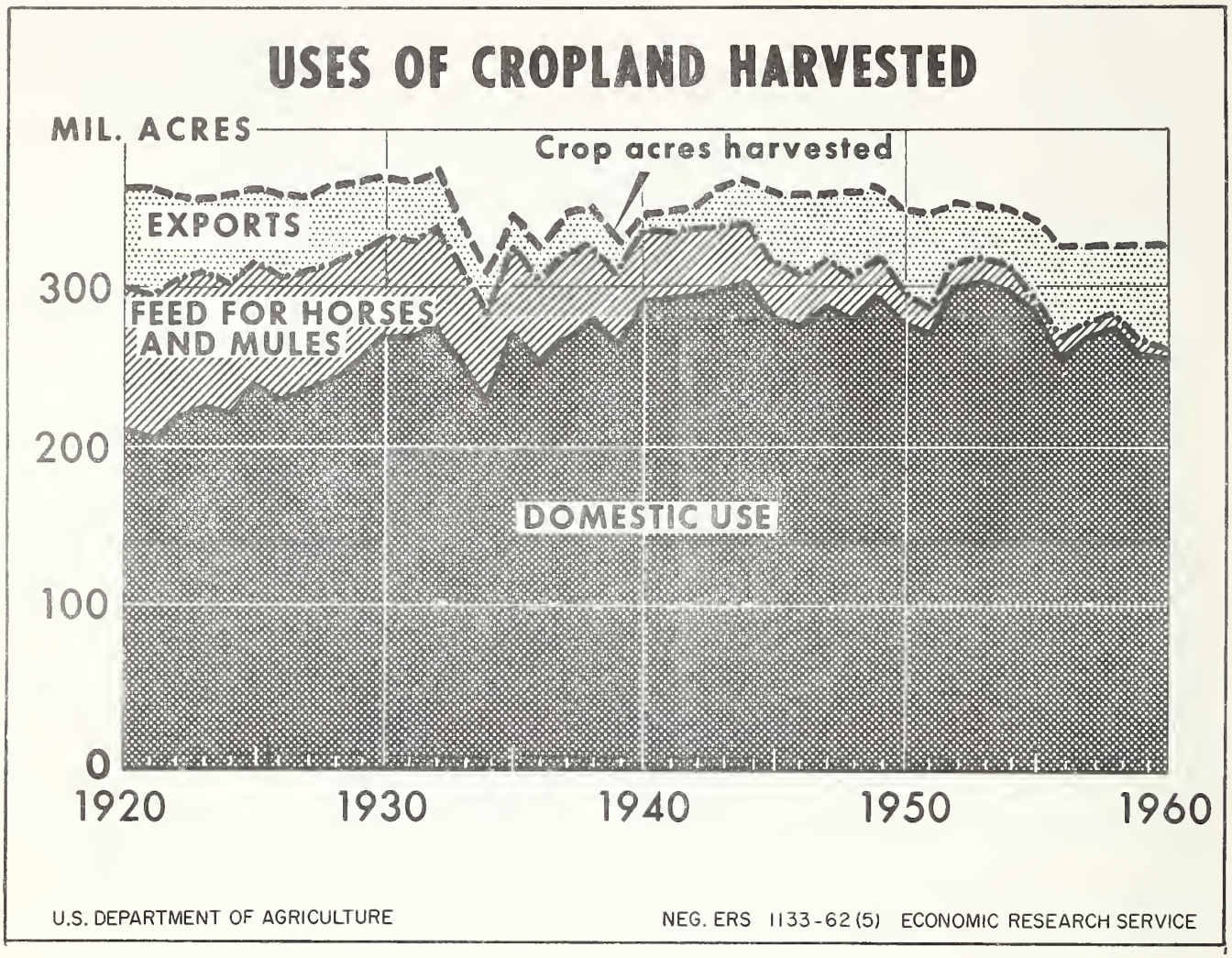

Figure 7

Impact on Agriculture

We are all well aware that the structure of agriculture has undergone tremendous adjustments since 1920. In general, these adjustments have been in response to the adoption of technological innovations which have tended to create surplus land and labor resources in agriculture. That land and labor are currently in surplus does not mean that these resources have not reacted to the impact of technological developments; rather, their movement out of agriculture to new uses has not kept pace with increases in productivity.

To discuss at length manifestations of the impact on agriculture of the adoption of technological innovations would be redundant, but to emphasize the nature and magnitude of the adjustments a few

observations are made. In 1920, 30.1 percent of the population of the United States lived on farms; in 1960, the comparable figure was 11.4 percent. In absolute numbers, farms claimed more than 11 million fewer residents in 1960. 12/ During this 40-year period the number of farms declined from nearly 6½ million to less than 4 million, and the remaining farms have tended to become larger. Whereas in 1920 only 10.7 percent of the farms were larger than 259 acres, 21.8 percent exceeded this size in 1959. Also in 1959, 9.1 percent of the farms were larger than 499 acres and 3.7 percent larger than 999 acres, compared with 3.4 percent and 1.1 percent, respectively, in 1920.

Agricultural Land Use in Relation to Economic Growth

Economic growth is principally characterized by an increase in real national income that exceeds the rate of population growth. The result is that more people have more purchasing power to satisfy their wants. This is reflected in increased demands for goods and services which derive not only from the added numbers of people, but importantly also from the additional real income that each person has to spend.

Although agriculture has contributed substantially to economic growth through the adoption of technological innovations which have increased the productivity of labor in agriculture, released labor to other productive segments of the economy, and supplied food at moderate cost, agriculture has not generally shared proportionately in the benefits of this growth. The increase in demand for agricultural commodities has not kept pace with the increases in demand for the products of most other industries. Agricultural surpluses have accumulated and farm incomes have been relatively low. This situation stems from the price and income elasticities of demand for agricultural commodities relative to other products, important factors in explaining why agricultural acreages have remained relatively constant over the past four decades and why some agricultural lands have been shifting to nonagricultural uses.

Between 1920 and 1960 disposable personal real income per capita about doubled, yet the per capita consumption of food was down from 1,542 to 1,465 pounds. Without regard to the composition of the diet, the aggregate demand for the physical volume (poundage) of food increases only at about the same rate as population. If aggregate productivity per unit of land used increases more rapidly than

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12/ Figures relating to farm population are based on the old census definition of a farm residence. The new definition which is intended to remove from the farm population families who live in the open country but sell little or no farm produce would decrease the number of farm residents in 1960 by nearly 5 million, and would decrease the farm population as a percent of the total population to 8.7.

population, a characteristic of agriculture during the past 20 years, land use adjustments must take place or excess supplies will be produced. Because of the extremely low price elasticity of demand for agricultural products, small excesses of supply reduce prices, and thereby farm incomes more than proportionately. To maintain prices, Government storage programs have siphoned excess supplies off the market, but the need for basic land use adjustments to eliminate the production of excess supplies remains with us.

In a progressive economy land use adjustments within agriculture should reflect differences in income elasticities of demand for the various commodities. As consumer incomes increase, expenditure patterns change with regard both to the distribution of expenditures for food among the major food groups and expenditures for food relative to nonfood items. The aggregate income elasticity of demand for food is probably less than 0.2. Thus, the rate of increase in food expenditures would lag far behind the rate of increase in national income. But among the different agricultural commodities, the income elasticities of demand are vastly different. For example, recent estimates of income elasticities of demand for major food groups include meat animals, 0.48; dairy products, 0.09; poultry, 0.62; eggs, 0.04; fruits and vegetables, 0.16; and cereals, potatoes and beans, -0.23. 13/ The nature of the changing composition of the average American diet, perhaps largely in response to increased incomes, is shown in figure 8.

Reading from figure 8, we may note that relative to 1920, in 1958 on a per capita basis we consumed 22 percent more meats, poultry and fish; 10 percent more dairy products; 7 percent more fruits; and 27 percent more vegetables. But we consumed 44 percent less potatoes and sweetpotatoes, and 20 percent less flour and cereal products. Dietary changes of these magnitudes obviously dictate a dynamic land use pattern within agriculture. Over the past 40 years changes in the composition of our diets appear to be only imperfectly reflected in changes in the composition of the agricultural output.

As contrasted with the low income elasticity of demand for food, the elasticities are much higher for many other products of land. These include, among others, demand for recreation, industrial sites, urban dwellings, and highways. Demand for these nonagricultural uses of land will grow, not only in proportion to population, but also as a function of national income.

13/ Koffsky, Nathan M. Potential Demand for Farm Products. In Dynamics of Land Use--Needed Adjustment, Iowa State University Press, Ames, Iowa, 1961, p. 44.

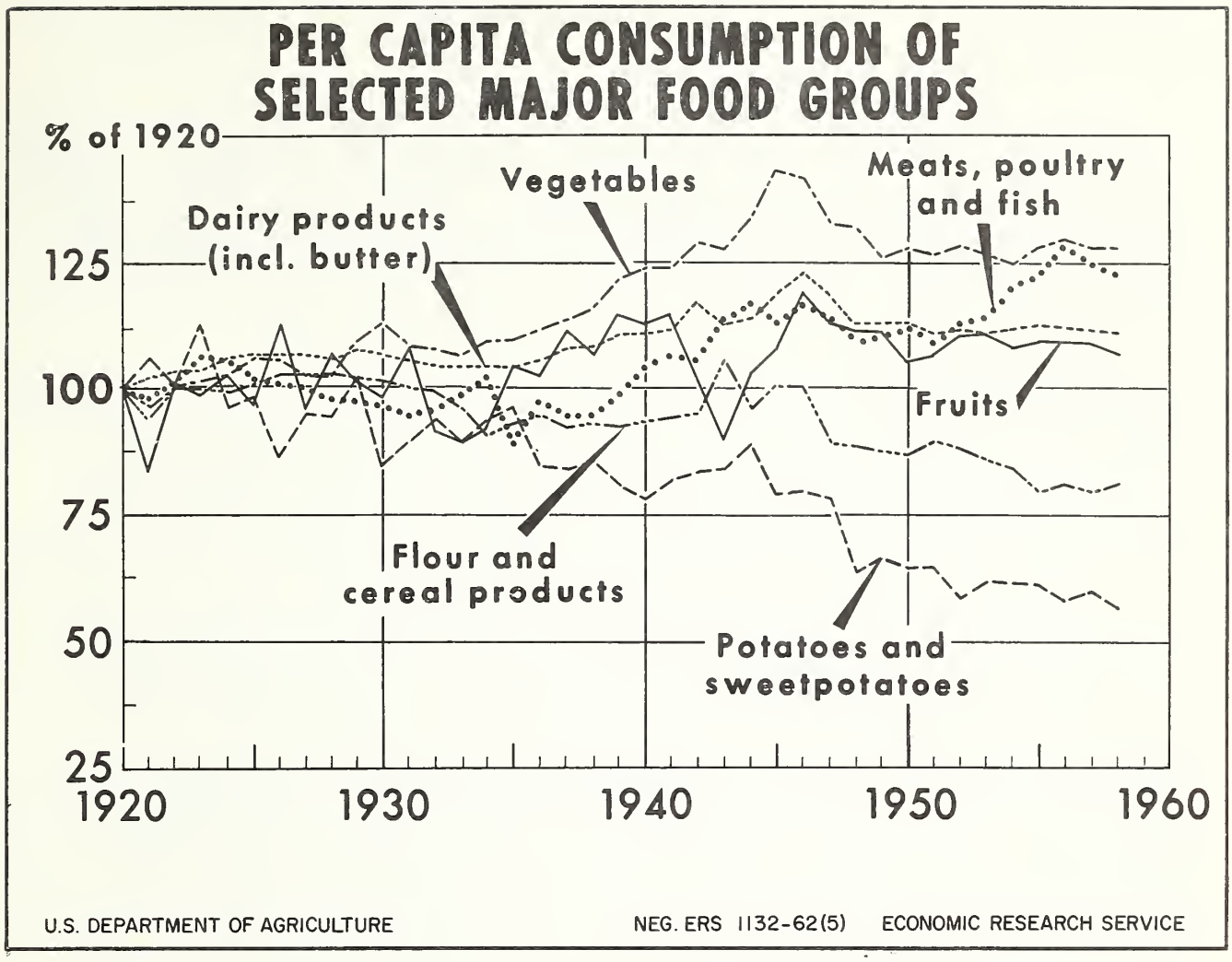

Figure 8

Forest Lands

The foregoing discussion has dealt mainly with farmland. Let us turn for a moment to the trends in forest land use.

As indicated in the map of natural vegetation (fig. 1), a large part of the farmlands of the United States were once virgin forests. The settlers dealt with these forests as an obstacle. Later, as the demand for lumber grew the remaining forests were exploited and cut over by timber companies. It has been estimated that in the eastern part of the United States an original forest area of over 680 million acres was reduced to a present commercial timber area of about 370

million acres. The reduction in the timber resource was much greater. The original volume of about 5,400 billion board feet was reduced to about 625 billion board feet. 14/

In the western part of the United States, forest lands were not usually suitable for farmland and National Forest reservations came early enough to save more of the forests. From an original area of 145 million acres, forest lands were reduced to 117 million acres. Volume was reduced from 2,240 billion board feet to 1,400 billion board feet. 15/

Forest management outside the National Forests was not seriously attempted until after 1920. Indeed, some authorities indicate that most large private industrial ownerships have been brought under continuous forest administration since World War II. 16/ On the smaller ownerships that together account for more than half the commercial forest land in the United States, progress has been slow.

Studies of the competition of forestry and crop production on land capability classes I-III indicate that usually crops have the advantage. Therefore, timber will be grown on about the present forest area plus some lands not needed for crop production. As pointed out in the Timber Resources Review, "forestry is a long-time undertaking." 17/ Action taken during the next 10 to 20 years will determine where the Nation stands in timber supply 50 to 70 years from now. This makes it imperative that programs be undertaken to improve the productivity of forest land in farm and other small ownerships where productivity is far below potential. Substandard stocking following harvest cutting is especially serious on these small ownerships, and they are the least adequately protected from fire, insects, or other losses. Timber quality is generally poor. We now face a serious problem of rehabilitating the small private forests of the Nation.

14/ Clawson, Marion; Held, R. Burnell; and Stoddard, Charles H. Land for the Future. Resources for the Future, Inc., Washington, D.C., 1961, pp. 286 and 297.

15/ Ibid.

16/ Stoddard, Charles H. The Small Private Forest in the United States. Resources for the Future, Inc., Washington, D.C., 1961.

17/ Forest Service. U.S. Dept. of Agriculture. Timber Resources for America's Future. Forest Resource Report No. 14, Washington, D.C., Jan. 1958, p. 1.

Future Demand for Land

To illustrate the future demand for land we will use projections to 1980 recently prepared by the USDA Land and Water Policy Committee. 18/ Although the Committee projected requirements for all land uses, including nonagricultural, in keeping with the assignment of this paper our subsequent discussion is focused mainly on projected requirements for agricultural purposes. A more complete discussion of the projected requirements and the assumptions underlying them is contained in the report by the Committee.

Principal Assumptions

The principal factors that will affect the future demand for products of land are the rate of population growth, the level of economic activity, consumer expenditure patterns, and the composition and level of exports and imports. Moreover, the availability and adoption of technological innovations as reflected through yields and feeding efficiencies will determine the transformation of demands for agricultural products into use requirements for land.

The rate of population growth is the most important factor affecting future demand for products of land. The population for the United States was projected at 261 million for 1980, an increase of about 48 percent over that of 1959. This projection is in accordance with recent trends in population growth.

Demand for the products of land also will be affected by consumer incomes, which are a function of the level of economic activity of the Nation. Measured in constant dollars so that the increases represent real gains, total disposable personal income was projected in 1980 to increase by 132 percent above that of 1959. This represents an increase of about 57 percent in disposable personal incomes per capita.

Per capita consumption of all farm products was projected to increase 2 percent by 1980, relative to 1959. Per capita consumption of all foods was projected to be up by 4 percent, representing an increase of 8 percent in consumption of livestock products and a decrease of 2 percent in consumption of crops. Per capita consumption of nonfood agricultural products was projected to be down 19 percent. These

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18/ On August 24, 1961, the Secretary of Agriculture formed a USDA Land and Water Policy Committee and directed it to prepare a preliminary report to "review the present and prospective land, forest and water resource situation, analyze its implications for Department policies and give program recommendations." This report was transmitted to the Secretary January 8, 1962. The preliminary report was subsequently revised and has recently appeared in its final version, Land and Water Resources - A Policy Guide, U.S. Govt. Print. Off., May 1962.

projected consumption estimates reflect anticipated upgrading of diets accompanying increased consumer incomes, and a continued increase in the use of such products as synthetic fibers and detergents, although at a slower rate than during the past decade.

The 1980 export goal for farm products was set at 30 to 35 percent above 1960 exports. This goal would include exports of 750 to 800 million bushels of wheat, 7.5 to 8.0 million bales of cotton, and 15 to 17 million tons of feed grains.

Based upon the foregoing assumptions regarding factors influencing the demand for farm products, the following increases over 1959 in farm output would be necessary to meet 1980 requirements: total farm output, 46 percent; total crop production, 42 percent; pasture production, 41 percent; and livestock production, 55 percent. Demand for timber in 1980 was projected at 16 billion cubic feet, an increase of about one-third over current annual consumption.

Assumptions about the availability and adoption of technological innovations are reflected in projected yields and livestock feeding efficiency. These projections are based mainly upon trends during the 1950's. Relative to 1959, per-acre yields of all crops were projected to increase by 56 percent by 1980. Pasture yields were projected to increase 35 percent. Timber growth, on the basis of recent trends, was projected to increase about 22 percent. The efficiency of livestock in converting grain and forage into meat was projected at 8 percent above that of 1959.

Land Requirements

Demand for the products of land was computed from estimates of the future magnitudes of principal demand determinants. Based upon projected estimates of yields and feeding efficiency, product demands were then transformed into major land use requirements. Figure 9 illustrates diagramatically the general projection scheme used, the breakdown of demand for agricultural products into its several constituents, the merger of constituent product demands to form requirements for major land uses and subordinate or multiple-purpose uses.

Total cropland required in 1980 to meet projected demands was estimated at 407 million acres, a decrease of 51 million from the 1959 acreage. Assuming that the acreage of crop failure remained constant and that the acreage of cultivated summer fallow declined by 7 million, cropland needed for crops in 1980 was estimated as 326 million acres, a decline of 33 million from that used in 1959. Harvested cropland requirements would total 291 million acres as compared with the 317 million harvested in 1959. The 33-million-acre reduction in cropland needed for crops, a decrease of 22 million acres in the amount of

SCHEME FOR PROJECTING LAND USE REQUIREMENTS

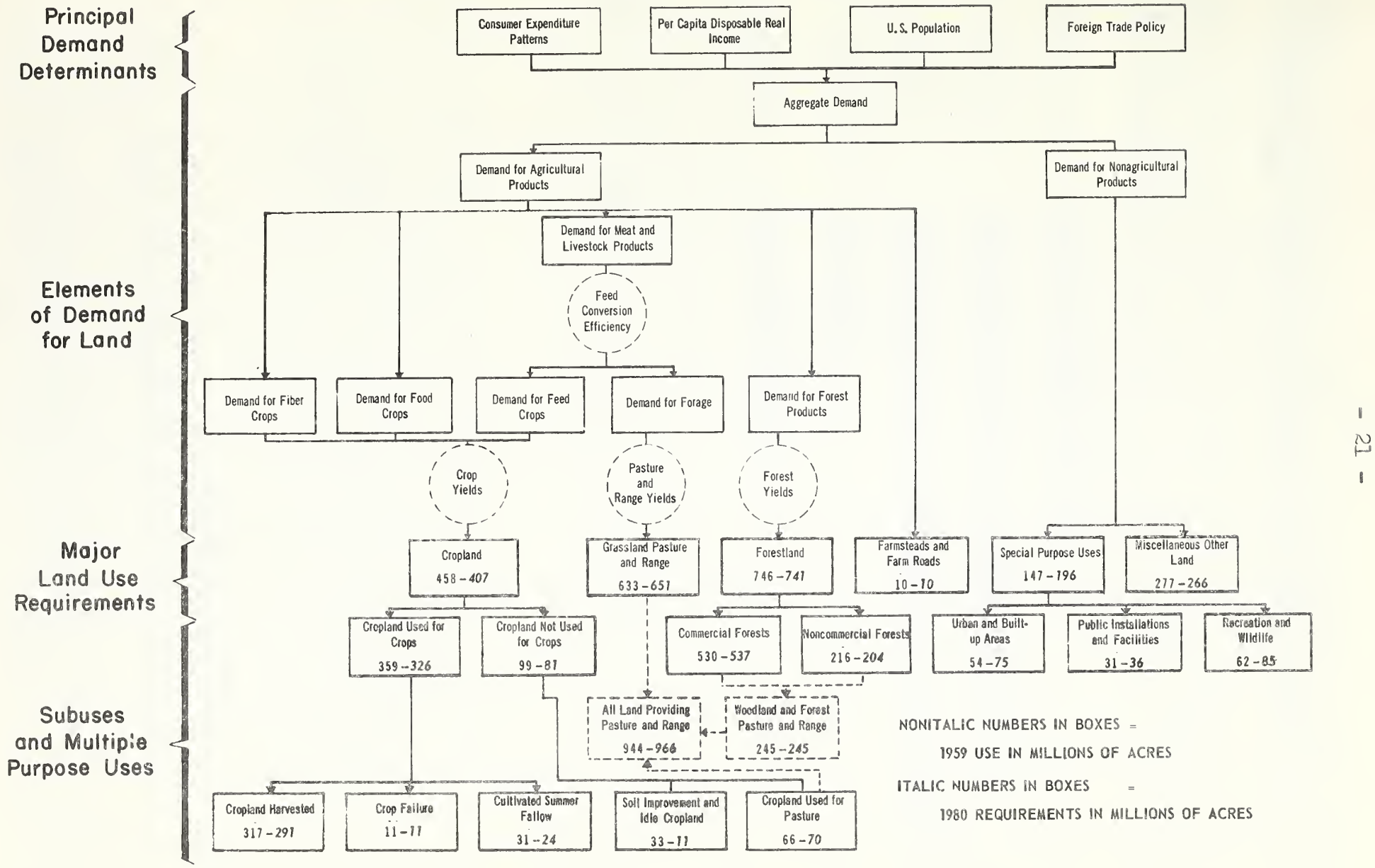

Figure 9

cropland idle or in soil improvement crops, and an increase of 4 million acres in cropland used for pasture sums to a projected net reduction of 51 million acres in total cropland requirements.

Less substantial adjustments than those required from 1959 are implied when the 1980 projected requirements are compared with 1961 cropland use. The Feed Grain and Conservation Reserve programs brought the amount of cropland harvested within 6 million acres and cropland used for crops within 12 million acres of projected requirements.

The demand for forage as reflected in increased demand for livestock products was projected to be greater than would be met from increased yields, requiring an increase of 22 million acres in pastureland. It was assumed that this requirement would be met by shifting 4 million acres of better cropland to cropland pasture and by shifting 18 million acres of less suitable cropland to permanent pasture. Since yields are higher on rotation pasture than on permanent pasture, the entire increased pasture requirement also could be obtained by increasing cropland pasture by 10 to 11 million acres. On the other hand, if the expanded demand for forage were met by permanent pasture alone, an increase in permanent pasture of between 60 and 70 million acres would be needed.

Needed growth to meet the projected demand for timber is estimated at about 68 billion board feet, or about 44 percent above present production. Projected growth based on the continuation of recent trends would fall short of needed growth by 14 percent. This deficit could be partially met by a small net increase in the acreage of commercial forest land but more would have to come from improved management. The deficit in timber production is expected to become increasingly serious after 1980. Prompt and very substantial expansion and intensification of forestry in the United States will be necessary if timber requirements after that date are to be met.

The greatest increase in requirements for land during the next two decades is expected to come from nonagricultural uses (fig. 10). Requirements in 1980 for special-purpose uses, which include urban and built-up areas, areas principally used for recreation or wildlife, and areas used for public installations and facilities, are projected as 196 million acres, an increase of 49 million acres from 1959 use. Miscellaneous other lands, which include desert, bare rock, swamp and other similar types of land, will supply part of the requirements for urban and other nonagricultural uses, and are projected to decline by 11 million acres.

Reliability of Land Use Projections

To project land use requirements specific estimates must be made of the future values of many variables. Variation of actual future conditions above or below these estimates would modify accordingly the requirements for cropland or other land uses. For example, a 1980 population projection 15 million below the 261 million projected by the Land and Water Policy Committee would have reduced cropland requirements by about 20 million acres. If the level of exports realized in

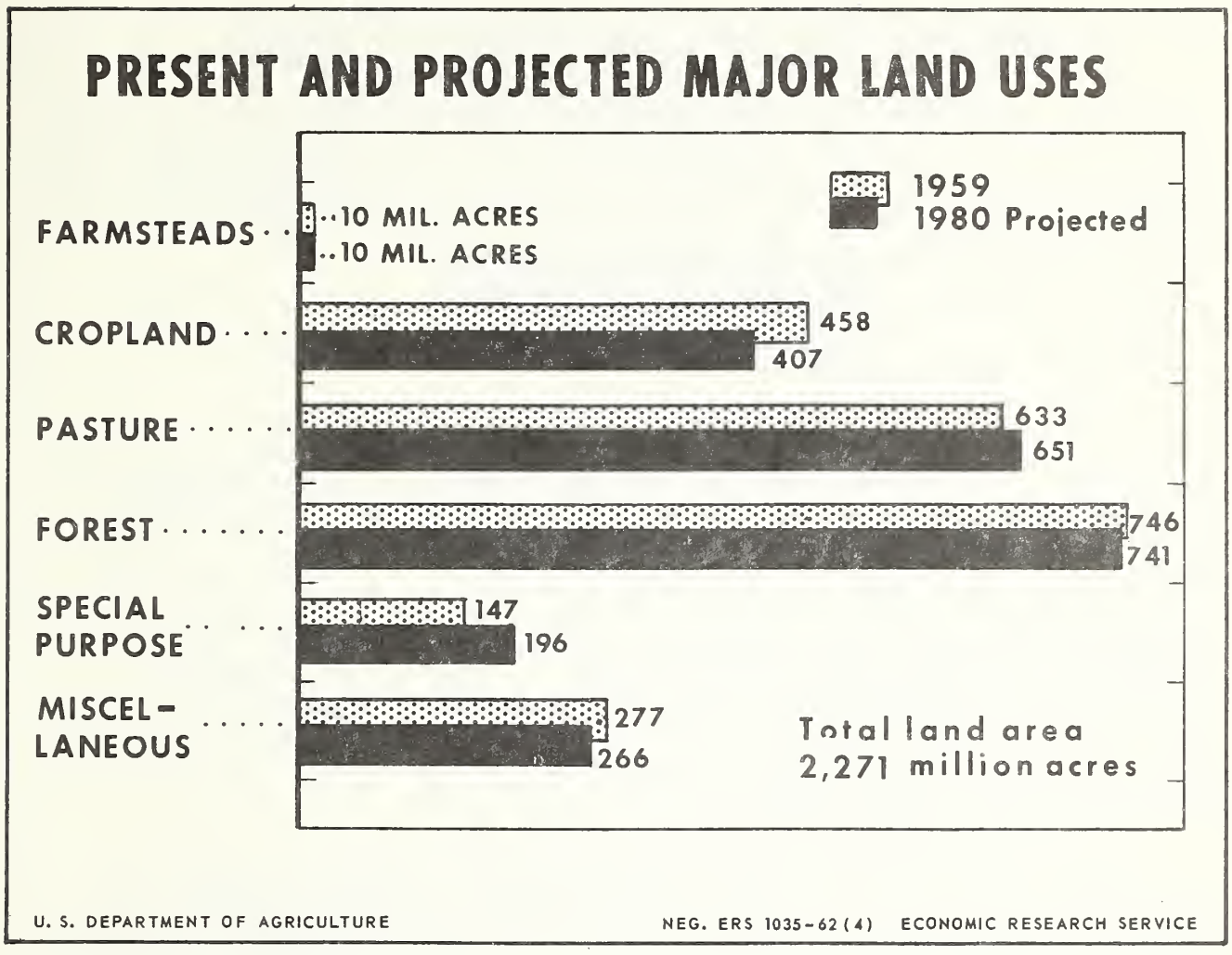

Figure 10

1960 or 1920 should prevail in 1980, cropland requirements would be reduced by about 15 million acres. A breakthrough in livestock feeding efficiency would further reduce cropland requirements. Projections of future land requirements, therefore, at best can be considered only as indicating probable directions rather than as absolute quantities.

The sensitivity of projections of agricultural demands for land to estimates of future demand determinants and resource productivities has been stressed elsewhere. 19/ The degree of sensitivity is indicated by the amount of variation in the several recent projections of cropland requirements in 1980. As contrasted with the projection of

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19/ Tolley, George S. Interrelated Land Development Possibilities. In Modern Land Policy, University of Illinois Press, Urbana, Ill., 1960, pp. 121-140.

407 million acres discussed in this paper, the medium level estimate of a recent study by Resources for the Future is 437 million acres. 20/ In the 1959 studies by the Senate Select Committee on National Water Resources, cropland requirements based upon a 1980 population estimate of 244 million were projected at 480 million acres, or about the total acreage in use in 1950. 21/ This projection reflected much lower crop yields than the 1962 study by the Land and Water Policy Committee on which this discussion has been based.

Potential Use of Land for Crops

In closing this discussion we will go a step beyond our assigned topic to briefly examine the amount of land potentially available for crop production. It has been estimated that crop production needed in 1980 could be produced on 407 million acres. There are 638 million acres of non-Federal non-urban land in capability classes I, II and III (fig. 11). Land in these capability classes is physically suitable for regular cultivation. Currently, about 113 million acres of this land is in pasture and range and could be fairly easily converted to crop uses if necessary, although some might require draining or other improvements. Clearing and other improvement likewise could make available for crop production about 125 million acres of forested land in these capability classes.

Approximately 169 million acres of class IV land is suited for occasional cultivation at high cost and with intensive conservation treatment. Only about 49 million acres of class IV land is currently used for crops. Thus, in extreme need considerable additional crop production could be obtained from these lands.

As a Nation we are fortunate to have such a large cropland potential. It is a valuable national asset which must be conserved for the future. As projections of future demands and requirements cannot have a high degree of accuracy the Nation should make provision for adequate land reserves which could be shifted to crop use in case of need.

20/ Fisher, Joseph L. and Landsberg, Hans. H. Natural Resources Projections and their Contribution to Technological Planning. Reprint No. 32, Resources for the Future, Inc., Washington, D.C., Jan. 1962, p. 123.

21/ U.S. Senate Select Committee on National Water Resources. Land and Water Potentials and Future Requirements for Water. 86th Cong., 1st sess., Comm. Print No. 12, U.S. Govt. Print. Off., 1960, p. 16.

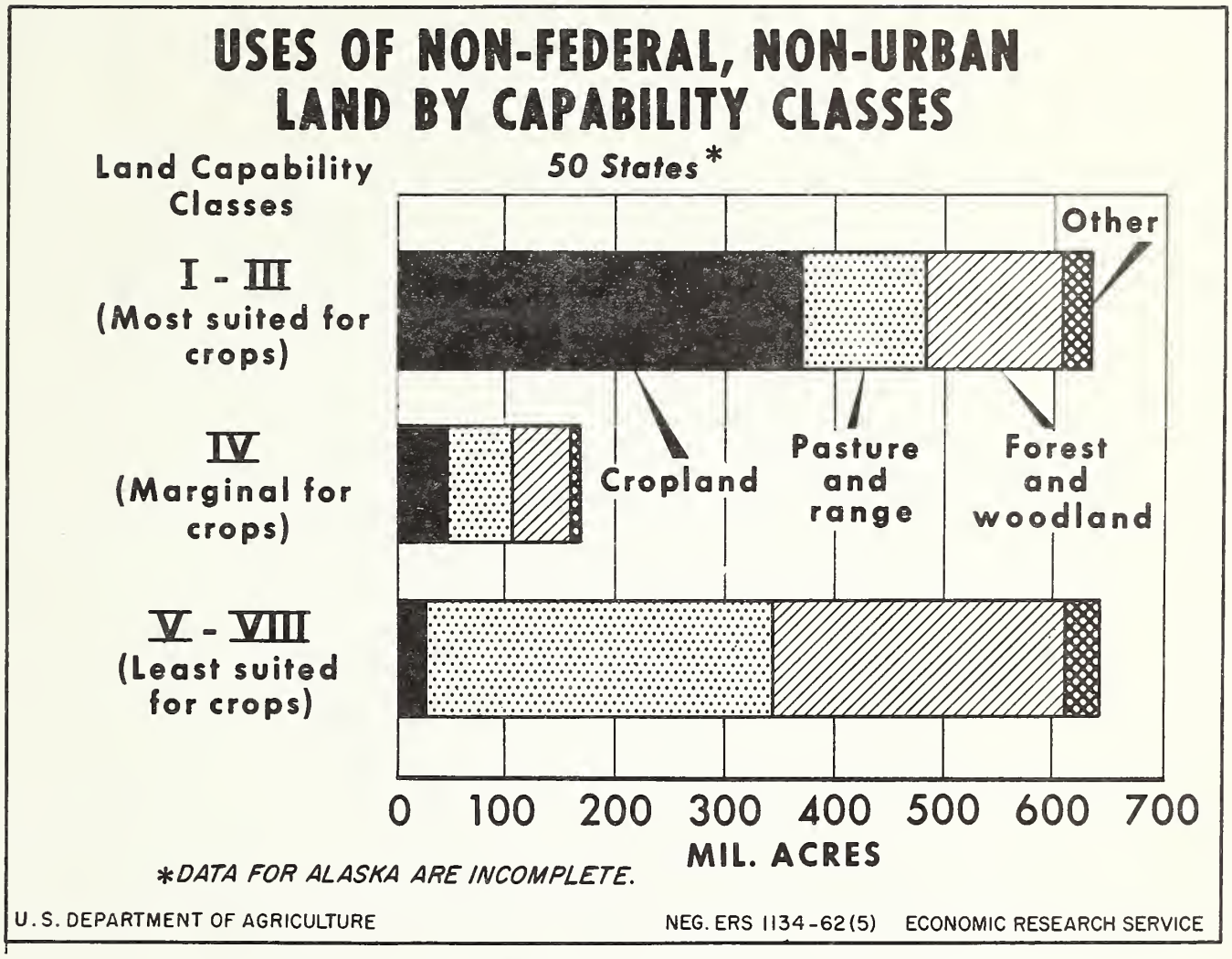

Figure 11

Analysis of the future demand for land has now become a part of our procedure in developing land use policy. We must improve our data and methods so that farmers, the general public, and legislative and administrative policymakers have a better basis upon which to make their decisions.